Lecture Module - Electrical Signals

ME3023 - Measurements in Mechanical Systems
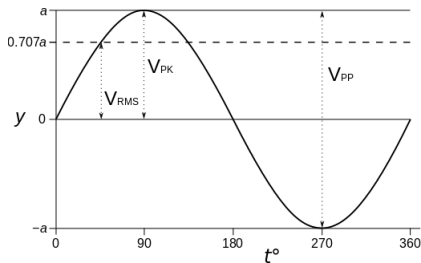
Mechanical Engineering

Tennessee Technological University

Topic 2 - Signal Analysis

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- Signal Mean Value

- Power Dissipation

- Signal Root Mean Square (RMS) Value

- Discrete-Time or Digital Signals

Signal Mean Value

Mean Value

$$\bar{y} \equiv \frac{\int\limits_{t_1}^{t_2} y(t)\,dt}{\int\limits_{t_1}^{t_2} dt}$$

Power Dissipation

Dissipation - Time Rate of Energy Dissipation

$$P = I^2 R$$

Total Electrical Energy

$$E = \int\limits_{t_1}^{t_2} P \, dt = \int\limits_{t_1}^{t_2} [I(t)]^2 R \, dt$$

Signal Root Mean Square (RMS) Value

- For a cyclically alternating electric current, RMS is equal to the value of the direct current that would produce the same average power dissipation in a resistive load.

- In Estimation theory, the root mean square error of an estimator is a measure of the imperfection of the fit of the estimator to the data.

- The RMS value of a signal having a zero mean is a statistical measure of the magnitude of the fluctuations in the signal.

Signal Root Mean Square (RMS) Value

$$(I_e)^2 R(t_2 - t_1) = \int_{t_1}^{t_2} [I(t)]^2 R \, dt$$

$$I_e = \sqrt{\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} [I(t)]^2 \, dt}$$

$$y_{rms} = \sqrt{\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} [y]^2 \, dt}$$

Table 2.1 : Theory and Design for Mechanical Measurements

Discrete-Time or Digital Signals

$$\bar{y} = \frac{1}{N} \sum_{i=0}^{N-1} y_i$$

$$y_{RMS} = \sqrt{\frac{1}{N} \sum_{i=0}^{N-1} y_i^2}$$

Table 2.1 : Theory and Design for Mechanical Measurements